



# THE EFFECT OF MINDFULNESS TRAINING ON COGNITIVE FLEXIBILITY AND COGNITIVE EMOTION REGULATION IN ELEMENTARY STUDENTS WITH LEARNING DISABILITIES: A RANDOMIZED CLINICAL TRIAL

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## ABSTRACT

**Introduction:** The purpose of this study was to explain the effectiveness of mindfulness training on cognitive flexibility and emotional cognitive regulation of elementary students with learning disabilities.

**Methods:** The present study was a pilot study with pre-test and post-test with control group. The statistical population of the study consisted of all four to sixth grade female students from Mashhad learning centers in the academic year 2019-2020. A sample of 30 people was selected from this community and pre-tested by Klasti sampling method. From this sample, 15 subjects in the experimental group and 15 in the control group were randomly assigned. Then, 12 sessions of mind-awareness training were applied to the test group. After the end of training sessions, both groups were subjected to post-test. The instrument used in this research was Cognitive Flexibility Inventory (CFI) and Cognitive Emotion Regulation Questionnaire (CERQ). Data were analyzed using covariance analysis.

**Results:** The results showed a significant improvement in cognitive anxiety scores and positive cognitive emotion regulation and reduction of negative cognitive emotion regulation in the experimental group compared with the control group. Therefore, mindfulness therapy can be used to help and help students improve psychological psychology of students with learning disabilities.

**KEY WORDS:** Mindfulness Training, Cognitive Flexibility, Cognitive Emotional Regulation, Learning Disorders.

## INTRODUCTION:

Learning Disorder (LD) is a neurological disorder-growth disorder among children that affects the interaction of effective environmental and genetic factors on the brain's ability to perceive or understand verbal or nonverbal information processing efficiently. Learning disorder is considered as neurological failure nerve that indicates cognitive dysfunctions of understanding, reading, writing and math (Cortiella & Horowitz, 2014; Sadock, Sadock, Sadock, & Ruiz, 2015). Learning disorders are characterized by one of the following symptoms:

1. Reading words incorrectly and painstakingly, difficult to understand meaning, spelling problems, difficulty in writing, difficulty in calculating numbers and difficulty in understanding mathematics;
2. The failure of ability results to interfere with educational activities and job function or daily activities;
3. These problems are started over the years of school; and
4. They have no interference with intellectual disabilities, vision or hearing problems and other mental or nervous disorders, lack of fluency in language and mental health problems (American Psychiatric, American Psychiatric, & Force, 2017).

Prevalence of learning disorders disability, dyslexia, mathematics disorder and dictate disorder have been reported as 9.7%, 8.7%, 6.7% and 7.2% respectively (Padhy et al., 2016). This disorder causes negative educational and psychological consequences and students with learning disorders may have problems in cognitive flexibility (Cortiella & Horowitz, 2014). Cognitive flexibility is identified as one of the most important aspects of executive function of ability to adapt with changes effectively. Environment, needs and objectives are constantly changing, in which the cognitive flexibility is considered as a vital factor in survival (Darby, Castro, Wasserman, & Sloutsky, 2018; Hayes & Strosahl, 2011). In one hand, the cognitive flexibility has positive effects on a person's ability to cope with internal and external stressors, as well as positive effects on welfare of family members in an interactive environment (Koesten, Schrod, & Ford, 2009), on the other hand, it plays a key role to form and develop different capabilities among people (Martin, Staggers, & Anderson, 2011).

Furthermore, learning disorder has a negative impact on individuals' emotional understanding which is evident in understanding of complex components of the excitement (Pons et al., 2014). Children with learning disorder are at greater risk of negative experiences than normal children (Bryan, Burstein, & Ergul, 2004). The cognitive emotion regulation refers to strategies that can affect the time of revealing emotions and how to experience and express them (Gross, 2014). The

cognitive emotion regulation means the type of an individual's cognitive processing when facing disaster and stressful events. Today, the new theories about emotion emphasize its adaptive and positive role, and show that emotion plays a constructive role in problem solving and information processing, decision-making process, innovation, creativity, and enhance learning (Roberts, Clarkson, Cummings, & Ragsdale, 2017).

The cognitive emotion regulation that affects the occurrence, severity, and expression of students' emotional responses (Baer, 2014; Joormann & Vanderlind, 2014) are matters that should be considered in students with learning disorders; mindfulness can provide the basis for achieving these goals. Mindfulness means paying special and purposeful attention to the present and imaginary time, without any prejudice and judgment. Mindfulness-based cognitive therapy requires specific behavioral, cognitive and meta-cognitive strategies to focus the attention process, which in turn prevents negative mood-creating factors, negative thinking, tendency to respond anxiously, development of new perspectives and formation of pleasant thoughts and emotions (Barmal, Salhi Fadardi, & TABIBI, 2018). This training method seeks to achieve the three main goals of attention regulation, creating metacognitive awareness and decentralization, and creating acceptance towards mental states and contents (Riemann, Hertenstein, & Schramm, 2016). Mindfulness includes various meditations, yoga stretching, review body exercises, raisin eating, mindfulness breathing and several cognitive therapy exercises that show the relationship between mood, thoughts, feelings and bodily sensations. All of these exercises provide some attention to physical and body situations in the present moment and reduce automatic processing (Kaviani, Hatami, & Shafieabadi, 2009). Schools often justify using mindfulness education programs because it promotes positive behavior and improves students' academic performance. It seems that mindfulness training, just as it has a positive effect on adults, can have a direct and indirect effect on students (Britton et al., 2014).

Studies on the effects of mindfulness training on cognitive control and cognitive flexibility on elderly and young subjects have revealed different and contradictory results. While some studies found significant differences in the emotion regulation, cognitive flexibility and depression scores between interventional and control groups (Barmal et al., 2018; Bouw, Huijbregts, Scholte, & Swaab, 2019; Kabirinasab & Abdollahzadeh, 2018; Li, Liu, Zhang, Liu, & Wei, 2018; Pirsig, 2017) while Hartkamp and Thornton (Hartkamp & Thornton, 2017) did not find significant difference between subjects.

## Objective:

According to the results of most of the previous studies, it can be said that as an educational method, mindfulness education could be effective in correcting psychological and educational processes of children with learning disorders. There-

fore, by considering effectiveness of cognitive therapies on learning disorders, in the present research we seek to investigate the effects of mindfulness training on cognitive flexibility and cognitive emotion regulation in female elementary school students with learning disorders in Mashhad.

## METHODS AND MATERIALS:

The present research method is quasi-experimental and its design is pretest-posttest with the control group and it was conducted in accordance with the Helsinki declaration and CONSORT statement. Its population included all female students in learning disorders' centers in Mashhad who studied in fourth to sixth grade in the educational year of 2019-2020. Using the available sampling method, we performed the Wechsler Intelligence Scale for Children (WISC) (Na & Burns, 2016) and *Colorado Learning Difficulties Questionnaire* (CLDQ) (Willcutt et al., 2011) among the referred and introduced students by teachers. Inclusion criteria included presence of students in schools with learning disorders, age range between 10 to 13 years, consent of parents, children and teachers; exclusion criteria included absence of more than two sessions, attending other psychotherapy sessions and another disorder other than learning disorder. 41 subjects were referred for this study, which eight were excluded due to exclusion and inclusion criteria and the parents of three subjects refused to be included in the study. Finally, 30 individuals were selected as the sample for our study. After parental consent and willingness of students to participate in the research, they were randomly allocated by first assigning four letter codes to each participant and then using excel program for simple randomization with allocation ratio of 1:1 into two experimental and control groups (each group consisted 15 students). All of the included participants completed the study and both groups were tested before and after performing mindfulness treatment in the intervention group. The CONSORT flow diagram for the subjects is depicted in the Figure 1. It should be noted that because of the ethical considerations, after the completion of treatment in the experimental group and performing posttest, consecutively 12 training sessions were performed for the subjects in the control group.

## Research Tools:

**Cognitive Flexibility Inventory (CFI):** Dennis and Vander Wal (Dennis & Vander Wal, 2010) prepared this inventory. It is a short self-report instrument containing 20 questions. This inventory is used to assess a kind of cognitive flexibility that is applied in success of individual to challenge and replace dysfunctional thoughts with efficient thoughts. Its scoring is based on the Likert seven-point scale, from highly disagree (1) to highly agree (7). The inventory aims to measure three aspects of the cognitive flexibility: a) understanding substitutive methods; b) perceiving control hard situations; and c) understanding substitutive justifications. Questions 2, 4, 7, 9, 11 and 17 are scored reversely. Using Cronbach's alpha, Dennis and Vander Wal (Dennis & Vander Wal, 2010) obtained 0.91, 0.91 and 0.84 for the total inventory, controllability perception and perception of different options respectively for reliability of the instrument; they earned 0.81, 0.75 and 0.77 for the variables using retest method. Also, Esmail et al. (Esmail, Hossein, Seyed Abdolmajid, & Azam, 2013) reported 0.71 as reliability coefficient using retest method of the total scale; for subscales of understanding substitutive methods, perceiving control hard situations and understanding substitutive justifications, they reported 0.55, 0.72 and 0.55 respectively. Dennis and Vander Wal (2010) obtained -0.39 for the inventory concurrent validity using Beck Depression Questionnaire; they reported 0.67 for its convergent validity using the cognitive flexibility scale of Martin and Robin. Esmail et al. (Esmail et al., 2013) obtained 0.67 for convergent validity of the inventory using the Resiliency Questionnaire; they also obtained -0.50 for its concurrent validity using Beck Depression Questionnaire.

**Cognitive Emotion Regulation Questionnaire (CERQ):** made by Garnefski et al., Cognitive Emotion Regulation Questionnaire (CERQ) is a questionnaire with 18 items (Garnefski & Kraaij, 2006). It scores cognitive emotion regulation strategies in response to threatening and stressful events of the life in the Likert five-option scale from never (1) to always (5). This tool is measured based on the following nine subscales: rumination or focus on thoughts, catastrophizing, self-criticism and other-criticism (negative strategies of cognitive emotion regulation), acceptance, refocusing on planning, positive reevaluation, considering viewpoint and positive refocus (suitable or positive strategies of cognitive emotion regulation).

Each the subscales of this questionnaire includes two items. The lowest and highest scores on each subscale are 2 and 10, respectively. The higher the obtained score, the more that strategy is used by the individual. In the conducted research by Garnefski et al. (Garnefski & Kraaij, 2006), the coefficients of positive, negative, and total questionnaire coefficients were obtained 0.91, 0.87 and 0.93 respectively using Cronbach's alpha method. Yousefi (Yousefi, 2007) reported the reliability coefficient of this questionnaire in Iranian culture. In a sample of subjects aged 19 to 20 years, the reliability was 0.82 using Cronbach's alpha method for the whole questionnaire. In their research, Balzarotti et al. (Balzarotti, John, & Gross, 2010) reported the structural validity of the cognitive emotion regulation questionnaire in a suitable level on an Italian sample. Similarly, in his study, Yousefi (Yousefi, 2007) examined validity of this questionnaire through general score correlation with scores of its subscales, which ranged from 0.40 to 0.68; all of them are significant. In examining validity of this questionnaire, through its correlation with depression and anxiety scores and general health questionnaire, the obtained coefficients were 0.35 and 0.37 respectively,

which all of them all significant.

## Intervention Method:

In the present research, intervention sessions included a combination of mindfulness general education training for children, made by Alidina (Alidina & Over-Drive, 2020), which was modeled based on Baer cognitive therapy of children version mindfulness (Baer, 2014). They were performed in 12 training sessions (twice weekly) that were last for 90 minutes. Table 1 represents descriptions of the sessions.

## RESULTS:

Table 2 represents the mean and standard deviation of the subjects' scores on cognitive flexibility and cognitive emotion regulation in pretest and posttest phases in both experimental and control groups.

Before performing covariance analysis, there were examined the equality of variances and the Mbox Test. In Levin's test for posttest, cognitive flexibility ( $p \geq 0.0861$ ,  $F = 0.031$ ), negative strategies of cognitive emotion regulation ( $p \geq 0.249$ ,  $F = 1.38$ ) and positive strategies of cognitive emotion regulation ( $p \geq 0.698$ ,  $F = 0.153$ ) were not significance that indicates considering condition of equality of variances. Also, there was performed the Mbox test to investigate the matrix-covariance homogeneity condition, which due to its lack of significance in the present research, this condition has been observed ( $P \geq 0.0452$ ,  $F = 0.958$ ).

Multivariate covariance analysis was used to investigate the effect of mindfulness training on cognitive flexibility and cognitive emotion regulation in children with learning disorders, which its results can be seen in Table 3.

According to Table 3, there is a significant difference between the experimental and control groups in terms of at least one of the dependent variables. To examine this effect more closely, the one-way covariance analysis was performed in the covariance context on dependent variables. Table 4 shows the results of one-way analysis of covariance in context of covariance analysis to compare posttest scores, by controlling the pretests of all dependent variables in the experimental and control groups.

The results of Table 4 show that by controlling pretest, we can see a significance difference between the experimental and control groups in terms of cognitive flexibility ( $p \leq 0.001$  and  $F = 403.94$ ), the negative strategies for cognitive emotion regulation ( $p \leq 0.017$  and  $F = 285.49$ ) and the positive strategies of cognitive emotion regulation ( $p \leq 0.001$  and  $F = 588.03$ ). In other words, mindfulness training has had a significant effect on increasing cognitive flexibility and positive strategies of cognitive regulation and reducing negative strategies of cognitive regulation.

## DISCUSSION:

The present research aimed to evaluate the effectiveness of mindfulness training on cognitive flexibility and cognitive emotion regulation in children with learning disorders. The results of multivariate covariance analysis showed that there was a significant difference between pretest and posttest scores of cognitive flexibility in the experimental and control groups; in other words, mindfulness training has affected enhancing cognitive flexibility in children with learning disorders. This result is consistent with the obtained results by Li et al. (Li et al., 2018), Hartkamp and Thornton (Hartkamp & Thornton, 2017), and Kabirinasab and Abdollahzadeh (Kabirinasab & Abdollahzadeh, 2018). Cognitive flexibility focuses on the nature of learning in complex and unstructured environments, and the flexible individual is the one who can easily reorganize and apply knowledge in response to different situational demands. Individuals can break out of the current behaviors and thoughts' framework and experience more options and break the perpetual vicious cycle that results from their behaviors and thoughts using the stop technique and one-minute breathing space in mindfulness. On the other hand, it can be said that mindfulness is a positive ability that allows a person to think about alternatives and adapt to new conditions, which it is called flexibility. In fact, the conscious mind uses the meta-cognitive way of processing (Frewen et al. (Frewen, Evans, Maraj, Dozois, & Partridge, 2008)). Mindfulness is an unconscious feeling of consciousness that helps to clearly see and accept physical emotions and phenomena as they occur. Therefore, teaching it to children with learning disorders will enable them to accept their feelings and weaknesses, and accepting these feelings will reduce their attention and sensitivity to reporting these symptoms and improve their cognitive flexibility.

There was a significant difference between the experimental and control groups, in terms of cognitive emotion regulation; it means that mindfulness training had an effect on increasing positive strategies of cognitive emotion regulation and decreasing negative strategies of cognitive emotion regulation in children with learning disorders. This result is consistent with the obtained results by Bouw et al. (Bouw et al., 2019), Pirsig et al. (Pirsig, 2017) and Barmal et al. (Barmal et al., 2018). Emotion regulation involves conscious or unconscious processes that are used to increase, maintain or reduce emotional responses. When a person is faced with an emotional situation, it is not enough to feel good and optimistic to control the emotion, but the person needs to be aware of self-awareness in such situations and have the best cognitive function. Mindfulness can be effective in reducing and controlling emotions due to its deep mental connection with emotions. Mindfulness, because of its cognitive structure and at the same time, its flexibility and

non-judgment structure, establishes a deep connection between cognition and emotion. Due to increase the capacity to accept thoughts and emotions, there is no longer much opportunity to absorb negative and dysfunctional emotions and attitudes. As a result, their emotional processes and dysfunctional attitudes are reduced. On the other hand, there is not a deep connection in cognitive emotion regulation and affection, and occurs mostly in the layers of surface of the mind. While in mindfulness training, the relationship between emotions and feelings takes place at a deep level. Thus, mindfulness training improves a person's emotions and allows them to use their conscious and flexible attention to distance themselves from emotional and habitual reactions and to respond appropriately instead of reacting inappropriately to the situation.

#### Limitations and Recommendations:

One of limitations of the present research was that the sample was limited to children with learning disorders that would be considered in future studies by other groups such as hyperactive children. Another limitation of this research was to use self-report questionnaires to evaluate variables, which may lead to bias in answering questions, which in future research, it is better to use interviews and observations to improve this limitation. Lack of control of the used drugs by students is another limitation of this research. It is recommended that researchers and psychotherapists, and especially educational psychologists, use mindfulness

training to improve cognitive flexibility and emotion regulation.

#### CONCLUSION:

The results of our study showed that in terms of cognitive emotion regulation there was a significant difference between the subjects which underwent mindfulness therapy and the subjects in the control group. These results show that mindfulness training has an effect on increasing positive strategies of cognitive emotion regulation and decreasing negative strategies of cognitive emotion regulation and can be suggested as a treatment method in children with learning disorders.

#### Conflicts of Interest:

The authors declare no conflict of interest.

#### Funding:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

#### Figure Legend:

Figure1: CONSORT flow diagram for the included patients.

**Table 1. Summary of twelve sessions of mindfulness training**

Sessions	Suggestion
One	A brief introduction to mindfulness training; examining performance of the autopilot and its differences from mindfulness one; mindfulness breathing training in two ways: puppet bear and breathing with top; playing the eyebrow game; holding pre-test
Two	Mindful breathing with top; focusing on the sense of taste; practicing mindfulness; pointing to the difference between describing and judging; playing the game of seeds and butterflies
Three	The bear play; teaching three concepts: emotions, bodily senses and thoughts
Four	Three-minute breathing training; water glass practice; invisible ball game; bubble meditation training
Five	The bear game; focusing on the sense of hearing; learning to listen consciously (accepting voice); playing cat and cow (mirror making)
Six	Mindfulness breathing training with flowers and candles; focusing attention on the sense of hearing; mindful listening training; physical scanning training; jumping game
Seven	Mindfulness breathing (breathing for three minutes); focus on sense of vision; mindfulness training, part I (drawing painting); pointing to the difference between describing and judging by examining an object from different angles; playing curios mind game
Eight	Awareness breathing using the puppet bear; focus on sense of vision; mindfulness training, part II (drawing painting); examining perceptual errors; meditation; romantic charity; playing the memory game
Nine	Mindfulness Breathing (breathing for three minutes); focusing attention on the sense of touch; mindfulness touch training; pointing to the difference between describing and judging by examining several objects with different roughness and softness; playing the sun and ice cream game
Ten	Mindfulness breathing (breathing for three minutes); focusing attention on the sense of smell; mindfulness smelling training; bubble meditation practice
Eleven	Mindfulness breathing (breathing for three minutes); experiencing awareness of moving body; step mindfulness; practice the pendulum movement
Twelve	Mindfulness breathing (breathing for three minutes); review of all trained mind-training exercises; study using mindfulness in daily life; holding posttest

**Table 2. Average and standard deviation of participants' scores in the research variables by separating the experimental and control groups**

phase Variable	Group	Pretest		Posttest	
		Average	Standard deviation	Average	Standard deviation
Cognitive flexibility	Test	61	4.84	85.66	5.55
	Control	57.46	4.20	57	4.61
Negative regulation strategies	Test	27.60	2.09	13.80	1.42
	Control	27.13	1.76	26.33	2.22
Positive regulation strategies	Test	21.06	2.15	37.46	1.68
	Control	21.20	2.45	20.60	1.84

**Table 3. Results of multivariate covariance analysis to compare posttest scores of dependent variables of the research of the experimental and control groups**

Effect	Test	Value	F	df theory	df error	p
Group	Pelagic effect	0.97	252.55	3	23	0.001
	Wilkes Lambda	0.02	252.55	3	23	0.001
	Hoteling effect	32.94	252.55	3	23	0.001
	The biggest root	32.94	252.55	3	23	0.001

**Table 4. Results of one-way analysis of covariance in Mankova test on posttest scores of the research variables in the experimental and control groups with pretest control**

Dependent variable	Sum of squares	df	Mean of squares	F	p	Effect size
Cognitive flexibility	4109.08	1	4109.08	403.94	0.001	0.642
Negative strategies of emotional regulation	1039.40	1	1039.40	285.49	0.001	0.619
Positive strategies of emotional regulation	1818.23	1	1818.23	588.03	0.001	0.659

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